Mulkey-Monache Allotments
Head Cut and Photo Point Monitoring 2003-2011
Monitoring Summary and Report (DRAFT)

Prepared By: Casey Shannon, Hydrologic Technician
Inyo National Forest
March, 2012

Introduction

Baseline monitoring sites were created in summer 2003 within the Templeton, Whitney, Mulkey and Monache grazing allotments on the Kern Plateau region of the Inyo National Forest to help understand recovery rates at sites experiencing degraded conditions. The Templeton/Whitney allotments were not grazed since 2000 and in a "rested" or currently un-grazed setting, while the Mulkey and Monache allotments grazing was continued. As a result of an appeal of the 2000 Templeton-Whitney Allotments Grazing decision, the Forest was instructed by the Regional Office (Region 5) to conduct monitoring in order to understand rates of recovery over a ten year period and at a later date analyze the allotments to determine how future grazing on the allotments would be managed. The monitoring includes observing active headcuts, previously treated head cut sites and other degraded sites (erosional features) in representative watersheds of the allotments in similar settings as feasible. The results of the Templeton/Whitney allotment portion of the head cut and photo point monitoring are discussed in a separate report.

Mulkey and Monache Allotments - Monitoring

The two actively grazed and neighboring allotments of the non-actively grazed Templeton-Whitney allotments on the Kern Plateau (Monache and Mulkey Allotments) were used for comparison, as a part of the overall monitoring plan to be undertaken on all four allotments. The Monache and Mulkey allotments monitoring sites are the focus of this report. Head cuts are defined as the top of an actively eroding stream channel or gully of various sizes that result in gully formation or incision below, and migration is caused by stream flow of various amounts and intensity over time as dictated by hydrologic processes, peak flow events and soil/vegetation conditions. Incised channels below head cuts in meadows tend to cause lowering of water table elevations and potentially cause shifts in vegetation types, lessening of soil moisture and may reduce the ability of stream channels to disperse the energy of peak flows and sediment onto floodplains. In addition, meadow down cutting can reduce their groundwater holding capacity that can affect the amount of downstream surface flow. Photo-points of existing erosional features were established as well to understand trends (upward - no change - downward) in terms of site stability, or existing watershed condition.

Treated head cuts (THC) are sites where previous treatment attempts were made to arrest head cut migration were set as photo-point monitoring sites to make visual, qualitative observations and to understand treatment effectiveness in various hydrologic settings. Photo-points were also established with markers and tags at degraded, unstable sites such as stream banks, gullies, and open riparian meadow sites within the representative monitoring areas. Previously created photo-points within the monitoring areas (circa 1993-1999) were repeated in 2003 and 2011 to give a broader range of perspective where available. Each monitoring site was given an alpha-numeric identity number (i.e., HC-364, THC 360, and PP-368) and corresponding tag at the site that was documented, mapped, photographed and initial written observations and measurements were made.

Monitoring site location maps are found in *Appendix A* and Head Cut Monitoring Site Data are found in *Appendix B* (Table 1). See photos and descriptions document, *Mulkey-Monache Allotments HC and PP Monitoring photos* for site comparisons from 2003 to 2011 (separate document). Individual site per site monitoring summaries are also described and documented in a separate report.

Methodology

Active Head Cut Monitoring Sites

Head cut sites were set up with two fixed monuments (re-bar posts with copper caps) set into soil and aligned perpendicular with a level reference line (twine) to the current location of each head cut face (top) to establish a baseline to measure over time the amount of upstream migration that may occur. In addition, a meter tape was pulled from the left bank facing upstream monument (LBU) over to the right bank facing upstream monument (RBU) to measure distance to the current LBU location of the head cut channel, the location of the channel thalweg and measure thalweg depth and the location of the RBU of the head cut channel and measurements were recorded. The monuments were placed apart enough in distance so they would not be affected by potential channel widening and a steel ID tag with a corresponding number (360, 368, etc.) was placed on the LBU monument for future identification. Photos were taken of each transect, channels and surrounding areas and monument locations for future reference along with recorded GPS positions later developed into GIS mapping and tables. A data dictionary (GPS) was utilized to collect site specific information at each site, i.e., vegetation types, slope, channel measurements, soil type, organic surface layer, aspect, and other transect measurements for reference and analysis considerations. With the established level reference line between monuments re-pulled at a later date along with a meter tape, the distance of upstream head cut migration along with widening and deepening of the channel could be measured, in this case seven years later. When the sites were revisited in 2011, this method was used along with measuring the lineal distance of any channel/gully migration that occurred since 2003. In addition, the width and depth of the current head cut and channel location was measured as well to help determine an estimation of soil loss associated with the head cut migration.

Photo-points

Photo-points were established with rebar or stone markers with fixed ID tags at degraded, unstable sites such as stream banks, gullies, and open riparian meadow sites within the representative monitoring areas. From the fixed monuments, repeat photos could be taken to replicate original photographs to visually track changes in vegetative cover, site stability and record observations. Selected treated head cut sites were also set up in a similar fashion to monitor treatment effectiveness and failures. Previously created photo-points within the monitoring areas (circa 1993-1999) were included.

Soil loss and Head Cut Migration Measurements

On Table 1, Appendix B the estimated amounts of soil loss and the distance of head cut migration is shown per site. The estimation of soil loss was determined by calculating a rectangular area by the width and depth of the channel at the original transect, calculating the same area at the new head cut 2011 location (measured manually with a tape) and using the length of migration to estimate cubic meters of soil loss. Head cut migration distance was measured in the field by using a meter tape from the original transect location (level line at transect between fixed monuments) to the new head cut location upstream, by following the channel thalweg on a lineal basis. With longer migrations over 5 meters, additional, random width and depth measurements were taken and averaged and used for the new head cut dimensions and soil loss calculations.

Monitoring Areas

Monitoring sites were established in the following areas within the allotments (maps in appendices show site locations). *Mulkey Allotment*: Bullfrog Meadow, Bear Meadow, Overholster Meadow, and Mulkey Meadow. *Monache Allotment:* Redrock Meadow and Cold Meadow. The monitoring areas/sites are discussed and summarized individually per allotment, showing monitoring results of the head cut (HC), treated head cut (THC) and photo-point (PP) sites along with other observations. This summary is based on site specific information of monitoring completed in August and September of 2011 of monitoring sites initially established in June and August of 2003 documenting site conditions, headcut migration rates and repeat of photo-points. The following discusses

the 2011 monitoring findings for the Mulkey and Monache allotments. Headcut monitoring data and monitoring site location maps for both Mulkey and Monache are found in Appendix A.

MULKEY ALLOTMENT

Bullfrog Meadow

Photo Points (PP) 368, 367, 366, 365, 364 - Head Cuts (HC) 369, 364 and Treated Head Cut (THC) 367

Photo-Points (PP's)

Five photo-points (PP) in the Bullfrog Meadow area were re-visited in 2011 and repeat photos were taken of the originals taken in 2003. The results of the monitoring show an overall increase of vegetative growth and less exposed soil as compared to the 2003 conditions at most sites. Vegetative cover is more robust and less soil erosion is occurring. Only one site, PP-366, is showing a slower increase of vegetative cover and stability and still shows a large area of exposed and eroded soil and potential for further degradation. However, the trend is a slower upward improvement as compared to 2003 as vegetation has increased on the terrace slopes above the stream channel. The other photo – point sites are showing noticeable indications of increased stability and vegetative improvement that is important towards soil erosion reduction and stream bank integrity.

Head Cut Sites (HC's)

Two Head Cut (HC) monitoring sites were established at Bullfrog Meadow in 2003, HC-369 and HC-364. HC-369 is located on a low gradient tributary stream to Bullfrog Creek on mostly recent alluvial deposits with a less developed organic layer on the surface. In 2003, this HC was showing active erosion and appeared to have the potential to rapidly migrate. 2011 monitoring showed the HC migrated 7.50 meters and has narrowed in size and width due to and small area of robust vegetation upstream of the 2003 HC location. It has developed into a two-step head cut and has diminished gully size. Due to the low gradient, narrow gully and high potential for alluvial deposition, the velocity of peak flows is slower and flows can access the floodplain easily, therefore reducing soil erosion potential and head cut migration. It is likely this HC will eventually slow and adjust to natural grade (gully formation will cease). HC-369 is not a high priority for stabilization treatment. HC-364 is located on a small tributary to Bullfrog Creek near the confluence. In 2003 the HC was small and moderately active and at the time more exposed soil was apparent at the site that a potential for migration was a possibility. 2011 monitoring showed little migration occurred (0.20 meter) and the site had become more vegetated with robust riparian growth (see photo monitoring document) and stabilized with little bare soil exposed. Head cut formation has slowed and the slope of the HC had diminished in grade. It is likely that this HC will eventually adjust to natural grade and excessive erosion will cease. HC stabilization treatment is not recommended.

Treated Head Cut Sites (THC'S)

One Treated Head Cut (THC) site exists in Bullfrog Meadow, THC-367. This site is located at the top end of a historically incised reach of Bullfrog Creek (head cut). Two large, primary headcuts were treated by Forest Resource crews in the early 1990's. The treatments are rock and filter cloth armored chutes, where the HC face was sloped lower to reduce flow energy and the exposed slope armored with rock to protect soil. The site when observed in 2003 showed stability and was meeting treatment prescription objectives. In 2011 when the site was re-visited, the upward trend and stability factor had increased and the prescription is fully effective in arresting the head cut and gully formation. Riparian vegetation is robust and stronger than in 2003, thus the treatment is very stable. The ongoing cattle grazing in Bullfrog has not had negative impacts to the treatment site and there is no apparent threat of treatment failure. No maintenance of treatment is needed or recommended.

Summary - Bullfrog Meadow Sites

Overall, the monitoring is showing an upward trend in terms of watershed stability of degraded sites observed in 2003. Vegetation appears to be more productive and developed, monitoring site erosion has lessened. It appears the area is showing less impacts and erosion than seen in 2003. With properly managed grazing practices, this trend could at least stay static or continue to improve.

Bear Meadow

HC-359 and THC-360

HC-359

HC – 359 in located in the middle area of Bear Meadow, a satellite meadow to Mulkey Meadow to the south. This HC was treated with a rock armor and filter cloth method in the late 1980's and the treatment later failed to stabilize the HC and head cutting resumed above of the structure. In 2003, monuments were set to observe migration rates. The setting is in an area of wet soil with deep organic and "A" horizon soil with well-developed riparian vegetation (mostly sedge and grasses, willows). 2011 repeat monitoring showed a small amount of upstream migration at HC-359 (0.60 meter) with some moderate widening of the gully below the HC (< 1.0 meter). The soil and vegetation conditions on the channel of HC-359 consolidated by rooted vegetation and consolidated soil, resistant to erosion, and the watershed upstream relatively small that typically does not generate large peak flow amounts. This site would be suitable for headcut treatment due to the moderate slope plus stable soil and vegetation conditions needed for successful headcut treatment. Recommend treatment of headcut.

THC-360

Near the HC-359 site is THC-360, a rock armored chute type headcut treatment completed in late 1980's. 2003 initial monitoring showed the THC in stable condition with surrounding vegetation showing signs of filling in around the structure important to stability and success of the treatment. 2011 repeat monitoring showed the trend of vegetative stability increased and treatment prescription being met. No need for maintenance at this time for THC-360.

Summary - Bear Meadow Sites

Bear Meadow is a wet, well developed riparian meadow with productive vegetation and appears to have few erosion problems associated with the stream channels at the time of 2011 monitoring. Vegetative cover in the meadow has moderately increased since 2003. HC-359, the primary in-stream erosion feature in Bear Meadow is slowly active and it is recommend for future monitoring to determine if head cutting has worsened. Monitoring shows the meadow is fairly resilient and erosion is not extreme.

Overholster Meadow

HC-363, PP-361, PP-362

PP -361, PP-362

PP-361 and PP 362 are stream side riparian sites located in mid-Overholster Meadow along Mulkey Creek. In 2003, the two sites exhibited bank erosion caused by cattle trailing through the sites in the form of exposed soil on the stream banks and missing vegetation. 2011 monitoring of these sites showed a moderate decrease in disturbed and exposed soil and increase of stabilizing vegetation. However, conditions at the sites have not yet fully recovered and are still vulnerable to disturbance (cattle grazing and water erosion).

HC-363

HC-363 is located on a tributary drainage to Mulkey Creek just outside of Overholster Meadow to the north, situated in dry upland soils. The HC site is the current location of the headcut caused the large, deep gully leading out of Overholster. The HC is vulnerable to high erosion rates as it exists in loose mineral soil. The deep roots of a large willow and lodgepole pine near the HC is slowing migration and additional gully formation and sediment delivery downstream. The HC has migrated only 2.30 meters since 2003 due to this condition, and has over-widened two fold with currently two points of headcutting (double HC). This site is not suitable for treatment due to loose, upland soils. There is no threat from HC-363 to the hydrologic function of Overholster Meadow as the headcut has previously advanced above the meadow into the uplands and new riparian floodplain is building and stable within the historic gully bottom in the meadow.

Summary - Overholster Meadow Sites

The monitoring sites at Overholster Meadow are showing an increase in vegetative cove and stability as compared to the 2003 monitoring. Although there is a noticeable upward trend in watershed condition and stability, areas of instability still exist. The two sites observed for PP monitoring indicate an increase of stability. Headcut site 363 does not pose a threat to the hydrology of Overholster Meadow as the historic impacts of the major downcutting event has started to reverse as the floodplain is redeveloping within the gully bottom is slowly aggrading upward to the abandoned floodplain that existed before the major down cutting event. Overall, willow growth has increased at the meadow noticeably and is adding stability to stream side reaches in Overholster Meadow.

Mulkey Meadow

<u>HC-371 and HC-372, PP's 356, 357, 358, and 370</u>

Photo-Points

All four photo-points listed above are located along the channel bottom of Mulkey Creek in lower reaches of Mulkey Meadow. Three of the sites established in 2003 are repeats of riparian photos taken in the early 1990's (La Barbara) and were chosen to give a longer term perspective of trend at the sites. What is noticeable at each photo point site is the increase of overall stability in terms of stream bank stability and floodplain vegetation development as compared to 2003. Point bars along the channel have increases of vegetative cover since 2003 and bare soil areas are now showing increased vegetative cover. However, there are still conditions not fully recovered and vulnerable at the sites, albeit in an upward trend, particularly with PP-370 a site located in a wet, fen like setting that was severely degraded in 2003 (bare ground and hummocks). Stream channel widths are showing signs of narrowing and channel depths have increased (ocular estimates) as well at most of the sites as healthy stream side vegetation has increased.

HC-371 and 372

HC 371 and 372 are found on a tributary drainage (Cow Camp Creek) upstream and near the confluence with Mulkey Creek. The two HC's are within ¼ mile of each other and are found within a historically incised channel and abandoned floodplain (terrace), currently a typical hydrologic condition found in Mulkey Meadow and tributaries. New floodplain and robust riparian vegetation is developing within the incised channels and are slowly increasing upward towards the upper terrace or abandoned floodplain. The two headcuts are active and moderately large, in 2003 appeared to have the potential for upstream migration given the right hydrologic events. The 2011 monitoring showed this did not occur over the 8 year monitoring period, both HC's moved little (HC-371, 0.52 meter and HC-372, 0.72 meter) and the scour pools below each HC have widened (estimated two fold since 2003) and the surrounding banks are unstable, with partially exposed sub soil and are moderately collapsing as each high flow event occurs. The watershed area upstream of the HC's is large enough to generate large stream flows and energy to initiate head cutting and there was a few runoff events large enough over the monitoring period to cause migration. However, this did not occur. The organic and "A" horizon soil layer soil is deep and concentrated,

combined with the robust riparian vegetation and deep plant rooting, soil erosion from head cutting was slowed considerably. The HC's could still have increased migration if additional ground disturbance occurs in the future and extreme hydrologic event occurs. HC-371 was previously treated (circa 1990) with a rock armored chute and the treatment later failed, the rock structure was abandoned and the HC has moved upstream (3-4 meters) likely due to poor implementation and design. Both sites have site conditions very favorable for treatment and it is recommended to treat both HC's.

Summary - Mulkey Meadow Sites

HC Sites

The two headcut sites in Mulkey Meadow showed little migration upstream since 2003, with moderate increase in channel width and increased bank instability due to scour cause by sudden hydraulic drop (vertical fall at headcut) and eddy scour below the HC. The two sites are suitable for treatment and are recommended for treatment. Stream banks immediately below the headcuts are vulnerable to additional erosion. Migration rates are slow due to high integrity of riparian vegetation and sod layer that is resistant to increased erosion when high flow events occur. The soil and vegetation conditions at the HC sites appear to be resistant in terms of high erosion rates and an unusual and substantial flow event/disturbance would be necessary to cause rapid upstream HC migration and gully formation.

Photo-Points

All photo points observed in 2011 show an upward trend in terms of site stability and vegetative recovery since 2003. Vegetative cover of previously disturbed and bare soil areas has increased markedly using visual comparisons. Site vulnerability still exists and increased disturbance may cause a reversal of improvement of the sites until additional stability occurs over time (continued upward trends).

MONACHE ALLOTMENT

Redrock Meadows

Redrock Meadows are located at approximately 8500 feet in elevation below Kern Peak and comprise the headwaters of Redrock Creek, a tributary of Ninemile Creek and Kern River. The meadows are very productive in terms of soil development, riparian vegetation and surface water from springs and seeps. Grazing use appears to be less than what occurs at other grazing units of the allotment, and some years the meadows are not used for grazing (per discussion with Forest Service Range administrator). The meadows usually are wet well into the summer months except dry years.

HC's 310, 314, 315, - PP's 308, 309, 313, 307, - THC's 311, 312

HC Sites

Three small headcuts were set up for monitoring in 2003 in Redrock Meadow. Two of the three (HC 310 and 314) have not shown upstream migration since 2003 and the vertical headcut faces (drops) have sloped to lower angles closer to the natural gradients of the sites and have increased vegetative stability. HC 316 is still active and has a head cutting form in place but has only moved 0.35 meter since 2003. This is likely due to the very robust riparian vegetation and cobble soil at the site holding stream banks and sub soil in place with little erosion. HC-315 has desirable characteristics for headcut treatment and treatment would have a high probability of success and resources are nearby to accomplish the task. However, this site would be of a lower priority for treatment versus other sites with a higher erosion factor. With the minor exception of HC 315, headcut degradation at Redrock Meadows is minimal with a low threat of advanced soil erosion.

Photo-Points

All four photo-points created in 2003 at Redrock Meadows were revisited in 2011. All sites showed visual increases in site stability since 2003 as riparian vegetation was more robust and developed. As a result, soil erosion at each site has decreased, and stream banks are showing less bare soil and missing vegetation as seen in 2003. One small site, PP-307 that is not a part of a stream channel showed slower recovery and has a higher potential for soil erosion if disturbed, but shows an increase in stability overall. As a whole, all four of the photo-points of erosional features in Redrock have shown an obvious increase in site stability as vegetation has increased and bare ground decreased. Sites are not fully recovered but are moving closer to overall stability.

THC's

Two previously treated head cut sites set up as photo-points in 2003 were observed in 2011 to determine treatment effectiveness and site recovery. THC-312, where a small HC was treated by only placing large pine tree branches around the headcut perimeter and along adjacent stream banks to protect exposed soils from cattle grazing showed the small HC had migrated approximately 8 meters upstream and is still active. This is a small HC only 0.20 meters wide and is located in robust stream side vegetation and has a low to moderate threat of upstream migration and gully formation. In retrospect, it would have been more effective to directly treat the active HC formation originally with a rock armoring treatment. This site is suitable for this treatment and is recommended, it is a minor amount of work required to treat the small HC. THC-311 was installed as a medium size log check dam structure (circa 1980's?) and spillway in the stream channel. The treatment has showed a continued trend of stabilization and is closer to meeting overall treatment prescription goals. Vegetation has filled in more robustly around the structure and the stream channel, creating a natural, stable geomorphic condition in balance with the stream channel above and below the structure. The stream channel floodplain area above and below has aggraded. No maintenance of further treatment is recommended for this site other than future visual monitoring when resource/wilderness personnel are working in the area at a later date.

Summary – Redrock Meadows Sites

HC Sites

The monitoring site conditions at Redrock Meadows have shown an upward trend towards stability since observed in 2003. Vegetative conditions and soil stability at the meadow sites are good considering the off and on grazing activities that occurs. Two of the three headcut sites are longer active and migrating upstream and have lost their original headcut formation (steeply faced) and have adjusted to natural grade, and stream bank stability has increased. One HC site (HC-315) is still active but has slowly migrated (0.35 meters) and is stable, a low threat of erosion at this site. This site is also very treatable and would therefore stop all upstream movement if done. Redrock Meadows has no major headcut concerns or no immediate threats to watershed stability as noted during this monitoring period.

Photo-points

All photo-points sites have shown upward trends in site stability and improvement since the 2003 baseline observations when sites were moderately degraded. Of note is the increase of robust riparian vegetation growth at all sites and the decrease of exposed, erosion vulnerable soil. The sites are not fully recovered yet, and could still have some vulnerability to disturbance and further erosion, but overall are showing strong productivity and resiliency.

THC's

One of the two THC's (THC-312) is in need of additional work to arrest a small and active headcut the treatment failed to address and could be remedied with a simple, rock armoring treatment. There is not a high threat of rapid upstream migration with this HC and the HC and gully are small in extent and scope, site conditions are stable in

terms of soil and vegetation. The other THC observed (THC-311) is fully functional and meeting prescription and there are no concerns.

Cold Meadows

Cold Meadows are located south west of Kern Peak and one of the more remote grazing units on Monache Allotment. It is at a higher elevation at 9,200 feet, and is overall very wet with several springs and seeps throughout the meadow forming small feeder streams that form Cold Meadow Creek. Dominant soils are deep organic layer and "A" horizon and riparian vegetation is dense and productive. The meadow was once treated for major head cut and gully formation, circa 1950's. The treatments have appeared to be effective and the meadow is now functional as gullies have aggraded to meet original floodplain elevations and major head cuts have ceased. The meadow has hydrologic and vegetative characteristics that are favorable for stabilization treatments.

HC's 316, 318,319 – PP's 318, 322,320 – THC-321

HC Sites

Three head cut sites were established in 2003 within the north-west arm of Cold Meadow. HC-316 and HC 319 migrated moderately (5.80 and 3.90 meters respectively) and the channel width and depth below each HC did not widen or deepen more than 0.10 meter since 2003. At HC-319, original monuments set in 2003 at the HC location could not be relocated due to extensive vegetative growth since 2003, the monuments were below the sod layer and an estimation of migration and channel width and depth were conducted based on 2003 site photos. Well vegetated stream banks, stable soils and relatively lower peak flows found at these sites slow erosion, although the migration distance noted is showing the potential for further HC migration. Overall, robust riparian vegetation has increased in these sites and are adding to stability. Both of these headcuts have favorable site conditions needed for head cut stabilization treatments. HC-318 only moved 0.30 meters upstream, well-vegetated and stable stream banks and soil helped to slow migration. This site is also suitable for HC treatment. At all sites the primary indicator is the notable increases of vegetation since 2003 and soil stability, and this helps to slow migration rates.

Photo-Points

Three photo-points were revisited in 2011 in the north-west arm of Cold Meadow. One of the sites (PP-322) has two viewpoints of the site (322-1A, 322-1B) of a 100 foot long section of degraded stream bank along the mid stringer in the meadow as noted in 2003. The points were adjacent to each other, depicting the overall condition of the degraded stream bank. Vegetative cover has increased (estimated 40%) since 2003 and this equates to 40 % less bare soil at the site since 2003. It appears the site is recovering at a moderate rate and is currently in a vulnerable condition, but less than in 2003. Stream side vegetation has notably increased and mostly recovered at these sites and vegetation is less on the upper slope above the stream, mineral soil is prevalent up slope and vegetation is usually slower to recover as soil moisture is typically lower on exposed soil slopes. PP-318 is near HC-319, it was a degraded stream bank where cattle trailing impacted the stream banks. Since 2003, the stream bank has mostly healed, with a small (est. 10%) area of bare soil left since 2003 and the rest of the disturbed area covered with robust riparian vegetation.

PP-320, in 2003 was observing a degraded stream bank where there are several seeps and springs and a high amount bare soil. It is estimated 50% of the bank has new vegetation covering the previous areas of bare soil and is moving towards stability, the site is still in a vulnerable state as a moderate amounts of bare soil exist on the steep section of the bank and the site is wet due to the elevated water table.
THC-321 is an old log check dam treatment installed circa 1950's as part of several in-kind treatments completed in Cold and Redrock Meadows. In 2003, the structure was found to be fully functional and meeting prescription. This treatment was designed to slow gully formation and elevate the gully bottom to the original floodplain terrace that existed before the gully was formed. The structure was revisited in 2011 and showed increased floodplain

development, the wood spillway is nearly subsurface, and stream flow is beginning to find its own course, meeting the long term goal of the treatment. Riparian vegetation at the site has increased and local water table is elevated.

Summary – Cold Meadows Sites

Headcut migration was moderate at two of the three HC sites and gully formation associated with HC migration was minimal as robust vegetation on stream banks with deep rooting help to hold dense organic soil together, and is resistant to erosion. Head cuts are still at risk as shown by the moderate migration rates since 2003. Both of these sites are suitable for treatment and are recommended for treatment. One HC showed less migration and could worsen if large flood events were to occur. Because the channels are not over-widened, deep and located on moderate to low gradients, large peak flows can easily spill onto adjacent floodplain areas, thus reducing the amount of erosional force within the stream channel. Photo points all show improvement and increased site stability in terms of increased vegetative cover with less bare soil exposed and ongoing erosion has diminished since 2003. However, the sites still are vulnerable and if disturbed to a high degree this trend could reverse. The treated head cut observed is continuing to improve and meet overall prescription goals. The meadows have shown a noticeable increase in terms of vegetative productivity and soil stability since 2003, and water tables in the meadow are elevated, this could be contributed to the above average water year in 2010 -2011 as well.

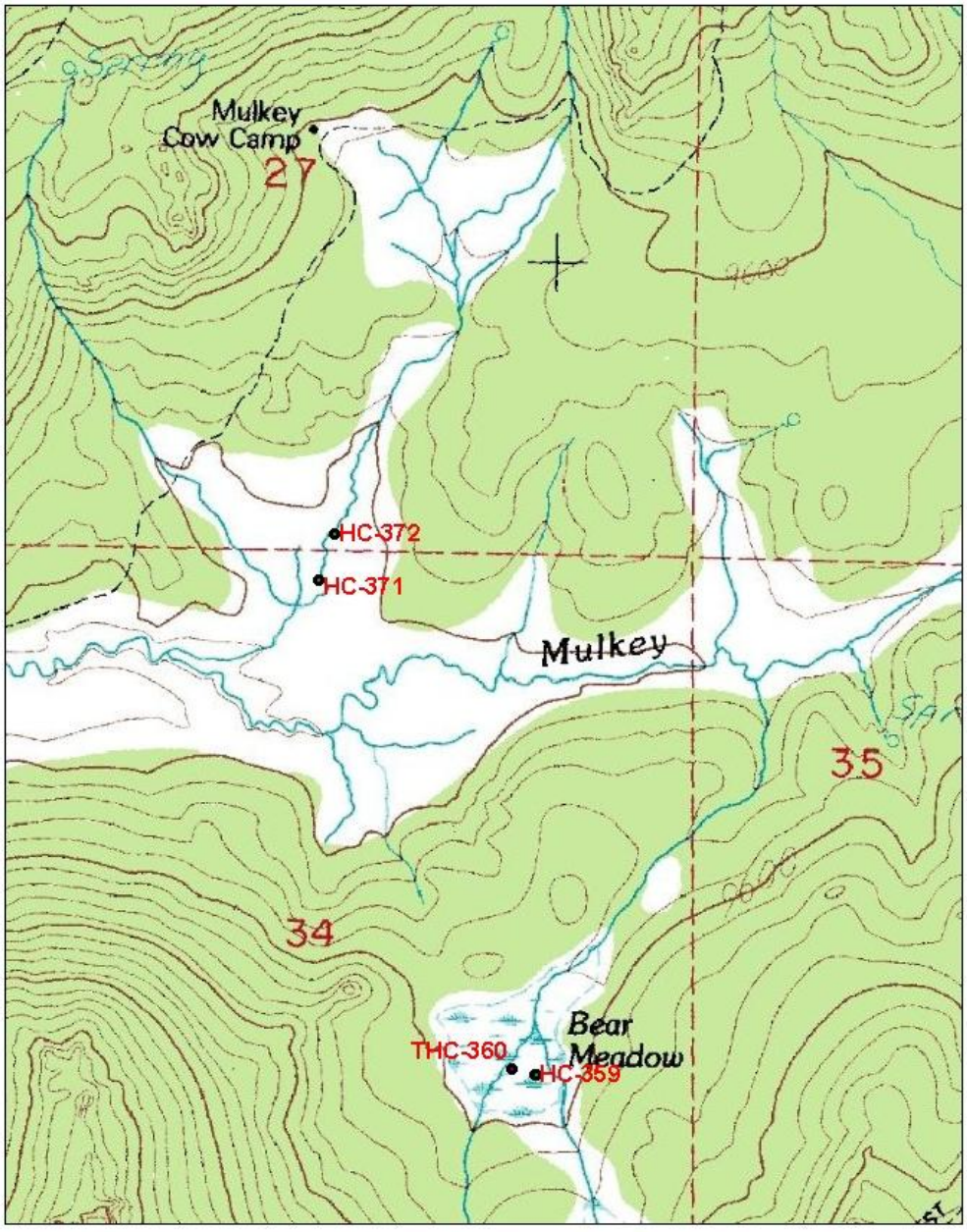
Acknowledgements

The following persons were instrumental with the establishment of field monitoring sites, methodology and with data collection in order to compile this report:

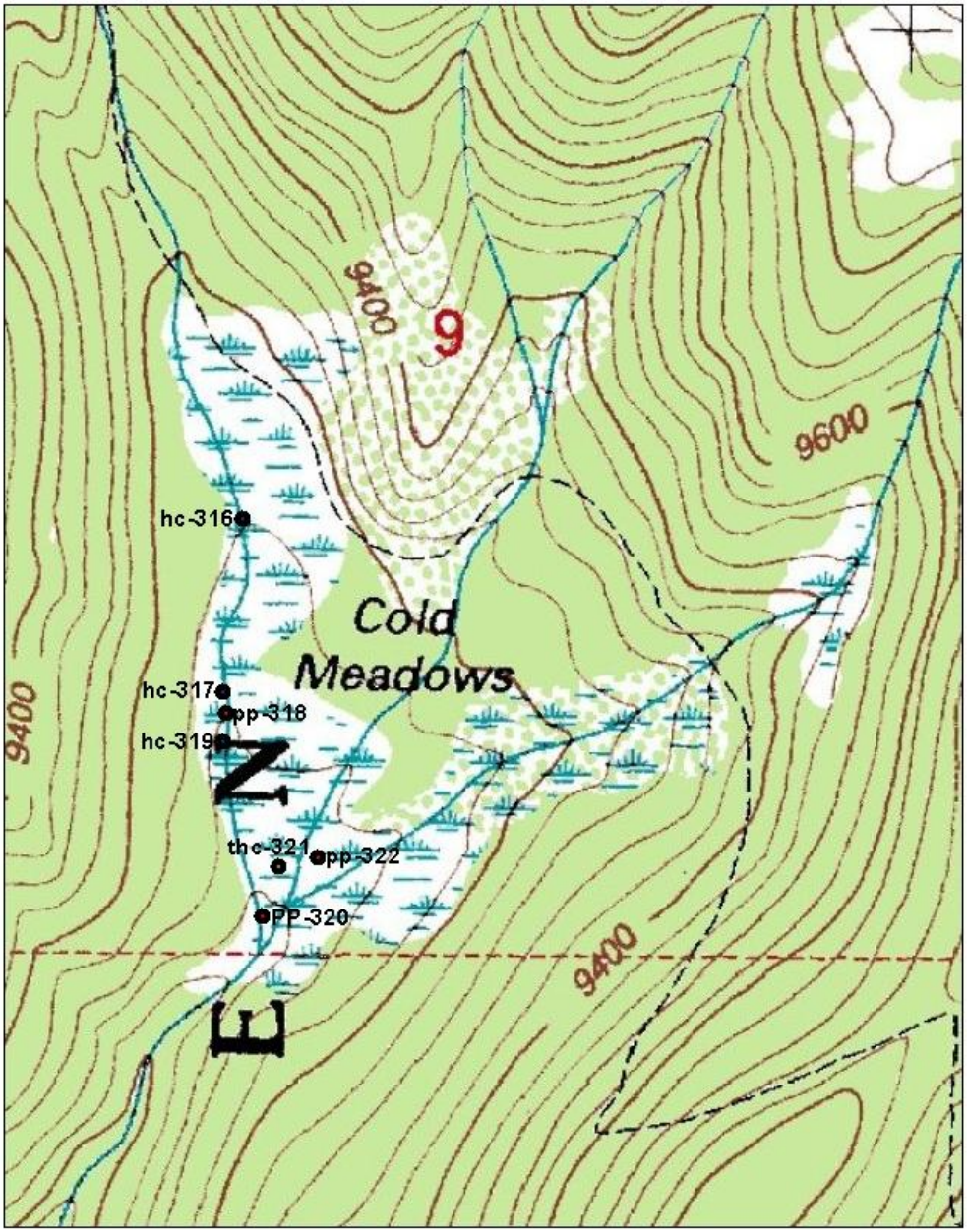
David Rains, Hydrologic Technician, Inyo National Forest, 2003
Heather Swartz, Range Conservationist, Inyo National Forest, 2003
Del Hubbs, Range Conservationist, Inyo National Forest, 2003
Nick Ettema, Fisheries Biologist, Inyo National Forest, 2011

Appendix A – **Monitoring Site Location Maps**

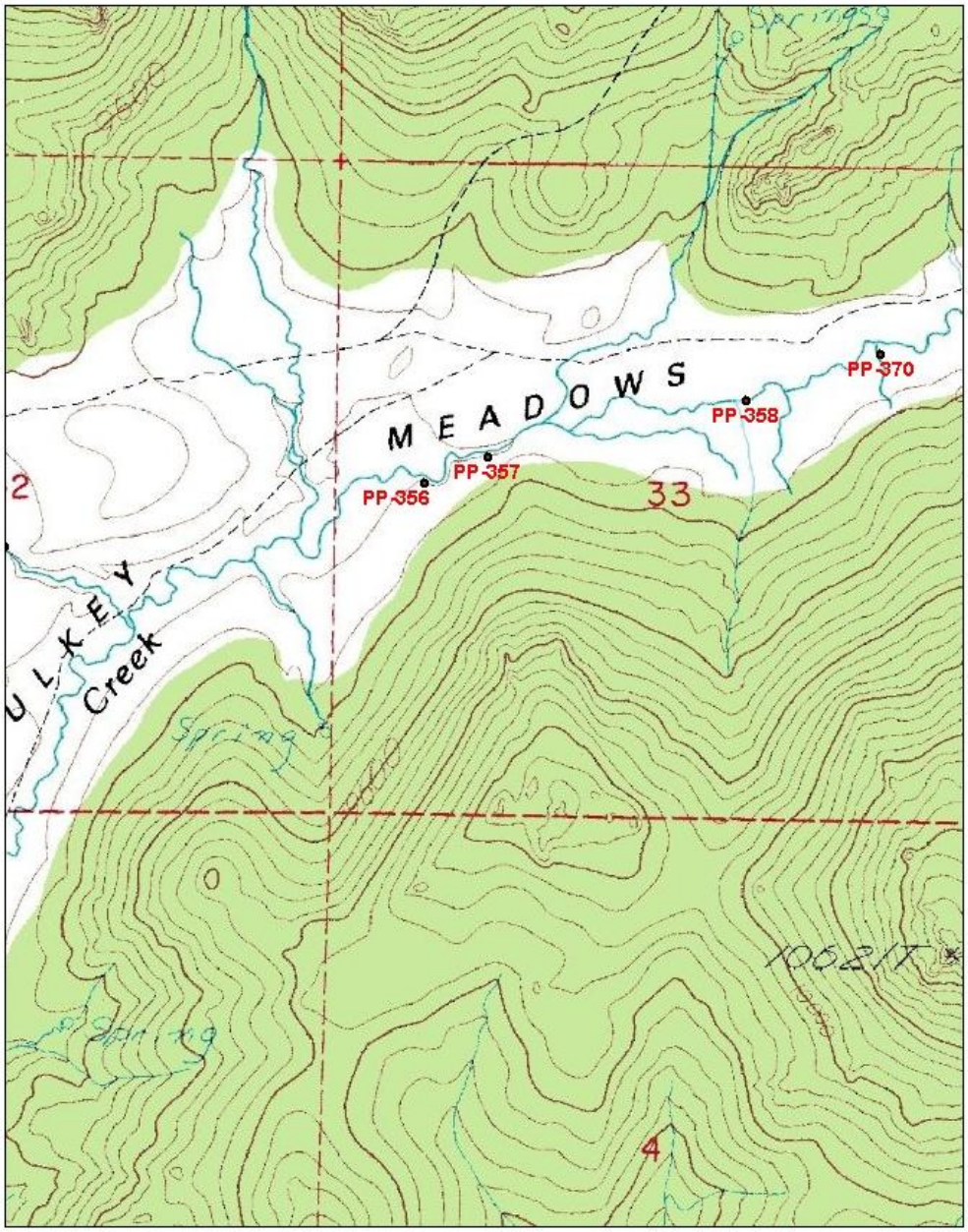
Upper Mulkey and Bear Meadow
Monitoring Site Locations



Cold Meadow
Monitoring Site Locations



Mulkey Meadow
Monitoring Site Locations

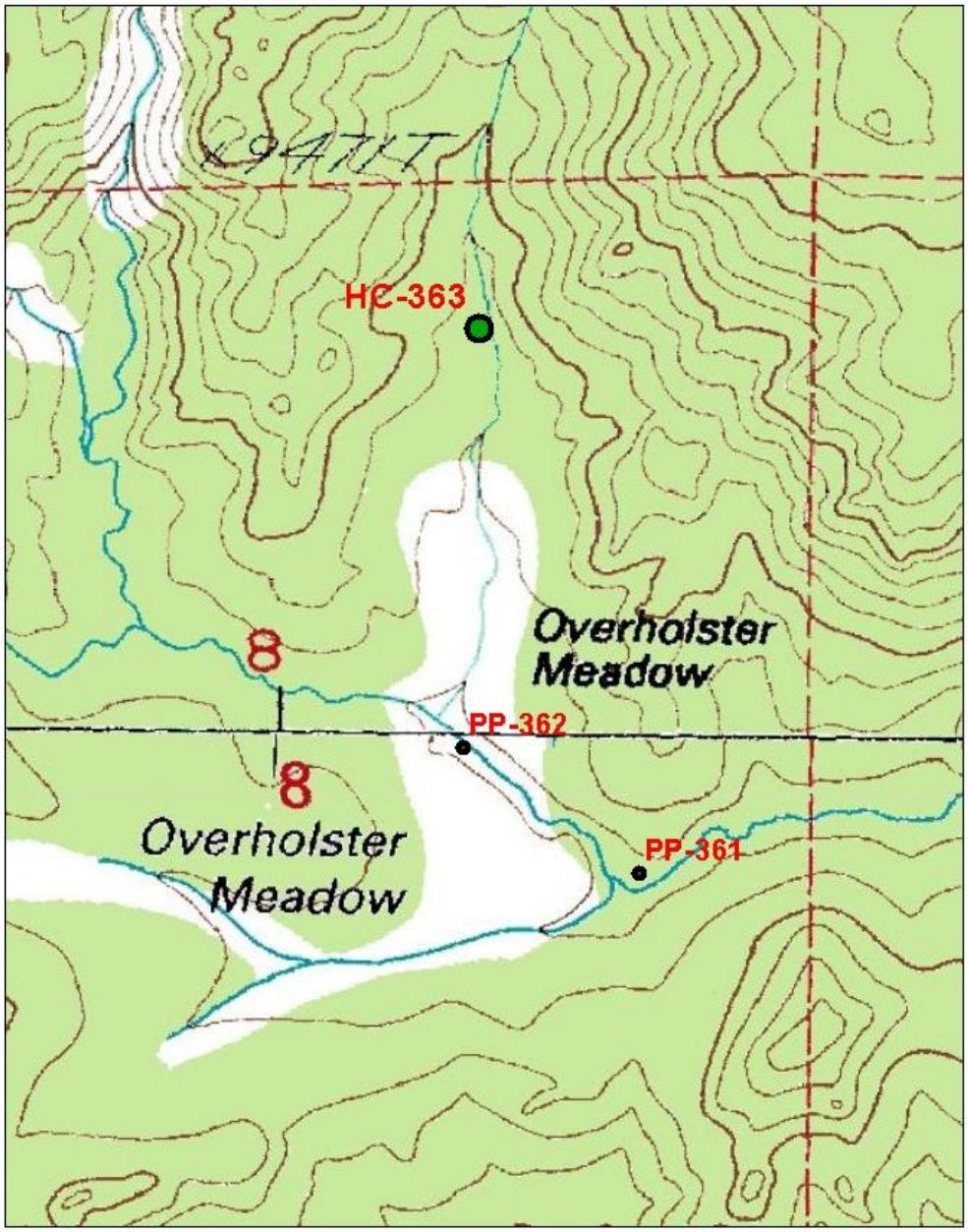


0 0.15 0.3 0.6 Miles

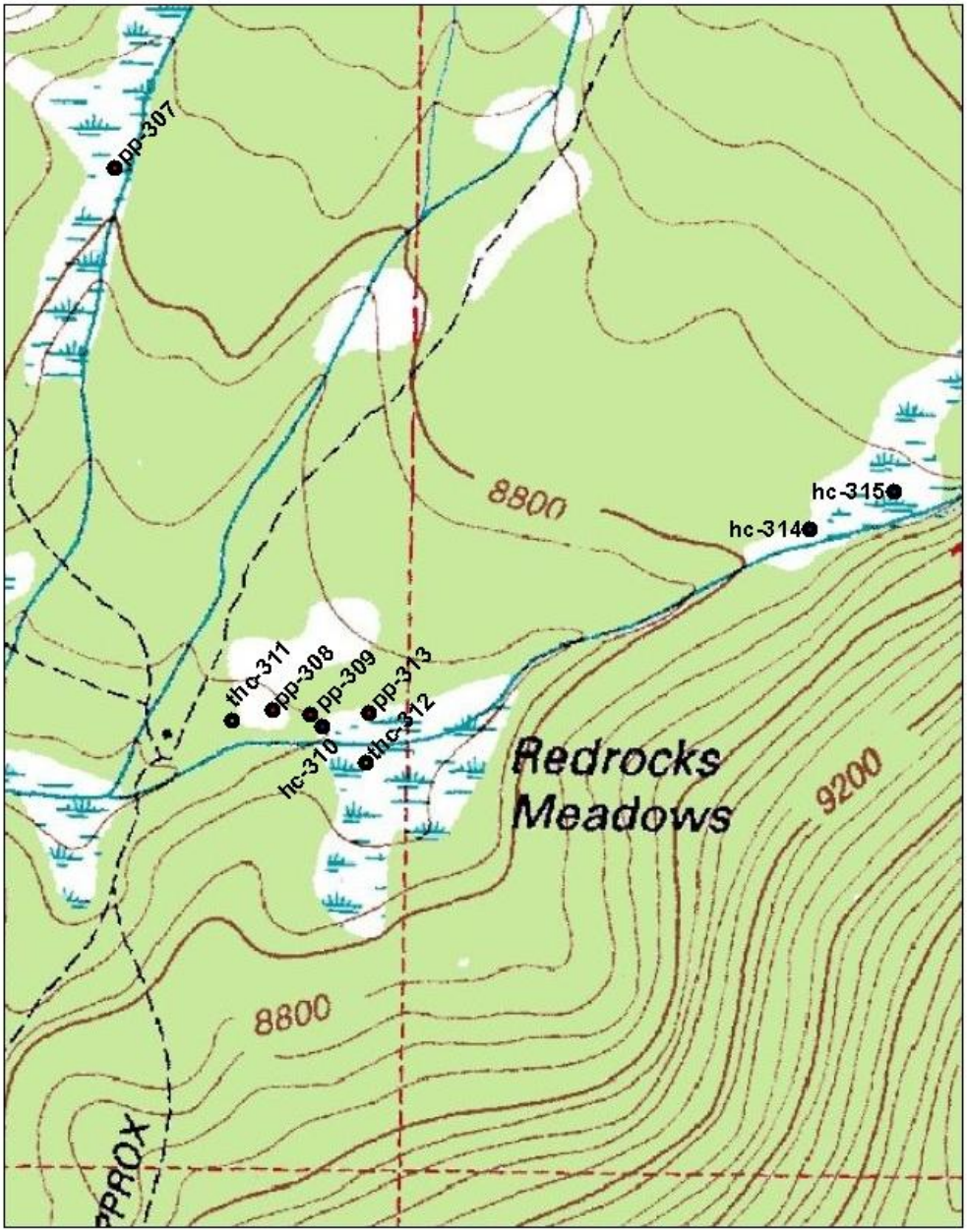
N

Scale 1:14000

Overholster Meadow
Monitoring Site Locations



Redrocks Meadow
Monitoring Site Locations



0 0.075 0.15 0.3 Miles

N

Scale 1:8000

Appendix B - Head Cut Monitoring Site Data – Mulkey and Monache Allotments - Table *1*

Head cut Site I.D. # - Monitoring Year	Meadow Name	Allotment	Slope %	Depth @ Thalweg (m) @ 2003 transect	Channel Width (m) @ 2003 transect	Depth @ Thalweg (m) (top of 2011 gully)	Channel Width (m) (top of 2011 gully)	HC Migration Distance since 2003 (length m)	Est. soil loss volume since 2003 (cu. m)
MONACHE HC SITES									
316 - 2003	Cold	Monache	3	0.78	0.15				
316 - 2011	Cold	Monache	"	1.11	0.35	0.50	0.40	**5.80**	**1.71**
Difference				0.33	0.2				
317 - 2003	Cold	Monache	3	0.50	0.60				
317-2011	Cold	Monache	"	0.89	0.37	0.30	0.35	**0.30**	**0.07**
Difference				0.39	-0.23				
319-2003	Cold	Monache	3	0.76	0.28				
319-2011	Cold	Monache	"	*	0.55	0.59	0.40	***3.90**	* = Transect lost, est. data for 2011
Difference					0.27				
310-2003	Redrock	Monache	10	0.35	0.60				
310-2011	Redrock	Monache	"	0.75	0.35	0.75	0.35	**0.00**	**0.00**
Difference				0.4	-0.25				
314 - 2003	Redrock	Monache	3	0.48	1.50				
314 - 2011	Redrock	Monache	"	1.11	0.62	1.11	0.62	**0.00**	**0.00**
Difference				0.63	-0.88				
315 - 2003	Redrock	Monache	3	1.35	0.70				
315 - 2011	Redrock	Monache	"	1.97	0.25	1.20	0.25	**0.35**	**0.14**
Difference				0.62	-0.45				
MULKEY HC SITES									
364-2003	Bullfrog	Mulkey	3	0.49	0.3				
364-2011	Bullfrog	Mulkey	"	0.51	0.25	0.48	0.80	**0.2**	**0.05**
Difference				0.02	-0.05				
369 - 2003	Bullfrog	Mulkey	2	0.73	1.4				
369 - 2011	Bullfrog	Mulkey	"	0.52	1.8	0.35	0.74	**7.50**	**4.48**
Difference				-0.21	0.4				
371 - 2003	Mulkey	Mulkey	2	0.6	0.63				
371 - 2011	Mulkey	Mulkey	"	1.4	0.55	0.62	0.52	**0.52**	**0.28**
Difference				0.8	-0.08				
372 - 2003	Mulkey	Mulkey	2	1.1	1.5				
372 - 2011	Mulkey	Mulkey	"	1.60	2.19	1.01	0.80	**0.72**	**1.55**
Difference				0.5	0.69				
363 -2003	Overholster	Mulkey	4	0.90	1.35				
363-2011	Overholster	Mulkey	"	1.68	3.28	0.90	1.50	**2.30**	**7.89**
Difference				0.78	1.93				
359 - 2003	Bear	Mulkey	4	0.50	1.48				
359 - 2011	Bear	Mulkey	"	1.05	1.05	0.60	0.45	**1.90**	**1.30**
Difference				0.55	-0.43				

Appendix C – Table 2

Precipitation Data-Maximum Snow Water Content (SWC) in inches, 2004 -2011
Snow Surveys, State of California - Kern Plateau Sites
(Reference: California Data Exchange Website, Department of Water Resources, 2012)

Data Site	2004	2005	2006	2007	2008	2009	2010	2011	April 1 Average SWC	Years Above Average April 1 SWC (since 2003 - 8 years)
Big Whitney Meadow	**16**	**30**	**26.5**	**3**	**20**	**13.5**	**19**	**30.4**	**17.2**	**5**
Cottonwood Pass	**13**	**30.5**	**21.5**	**7.5**	**14**	**9**	**18.5**	**28.8**	**14.8**	**4**
Tunnel Station	**13**	**25.2**	**21.5**	**5.5**	**19**	**11**	**18**	**25.02**	**15.6**	**5**
Ramshaw Meadow	**28.4**	**26.5**	**23.5**	**16.5**	**17**	**11**	**17**	**22.7**	**11.5**	**7**
Casa Vieja Meadow	**20.5**	**30**	**32**	**10**	**26**	**16**	**28**	**38.50**	**19.8**	**6**
Trail Head (east of Templeton Meadow)	**13**	**26.6**	**15**	**2.5**	**16**	**9**	**15**	**21.6**	**13.2**	**4**

Note: Data is for showing years of above average precipitation at snow survey sites of the Kern Plateau region to compare headcut migration rates. All sites are showing at least 50 % of the water years were above average. SWC maximums are based on April 1 or peak measurement of yearly amounts.